It has been observed in central Au+Au collisions at Relativistic Heavy Ion Collider (RHIC) that the yield of neutral pions at high transverse momentum ($p_T > 5$ GeV/*c*) is strongly suppressed compared to the one expected from p+p collisions scaled by the number of binary collisions. This suppression is considered to be due to the energy lost by hard scattered partons in the medium (jet quenching), which results in a decrease of the yield at a given p_T.

The magnitude of the suppression depends on the path length of scattered partons in the medium. Studying the path length dependence of energy loss should provide additional information on the energy loss mechanism in the medium. For example, some theoretical models suggest that the LPM effect in Quantum ChromoDynamics (QCD) plays an important role in radiative energy loss and predict that the magnitude of the energy loss is proportional to square of path length. We can estimate the path length by measuring the azimuthal angle from reaction plane and mapping it into the shape of the participant region, which can be calculated by Glauber model for each impact parameter (centrality).

We discuss the parton energy loss using the nuclear modification factor (R_{AA}) of neutral pion with respect to the path length. The integrated luminosity of RHIC-Year7 Au+Au run is 813 μb, which is 3.5 times larger statistics than that in RHIC-Year4 Au+Au run. Additionally, a new detector was installed to determine reaction plane more precisely. This detector is expected to provide better resolution for reaction plane determination. These advantages enable us to precisely measure the path length dependence of neutral pion suppression and discuss parton energy loss mechanism more thoroughly.